

1. Study of FEL Performance Sensitivity on Beam Main Parameters
2. The FEL Performance without External Focusing

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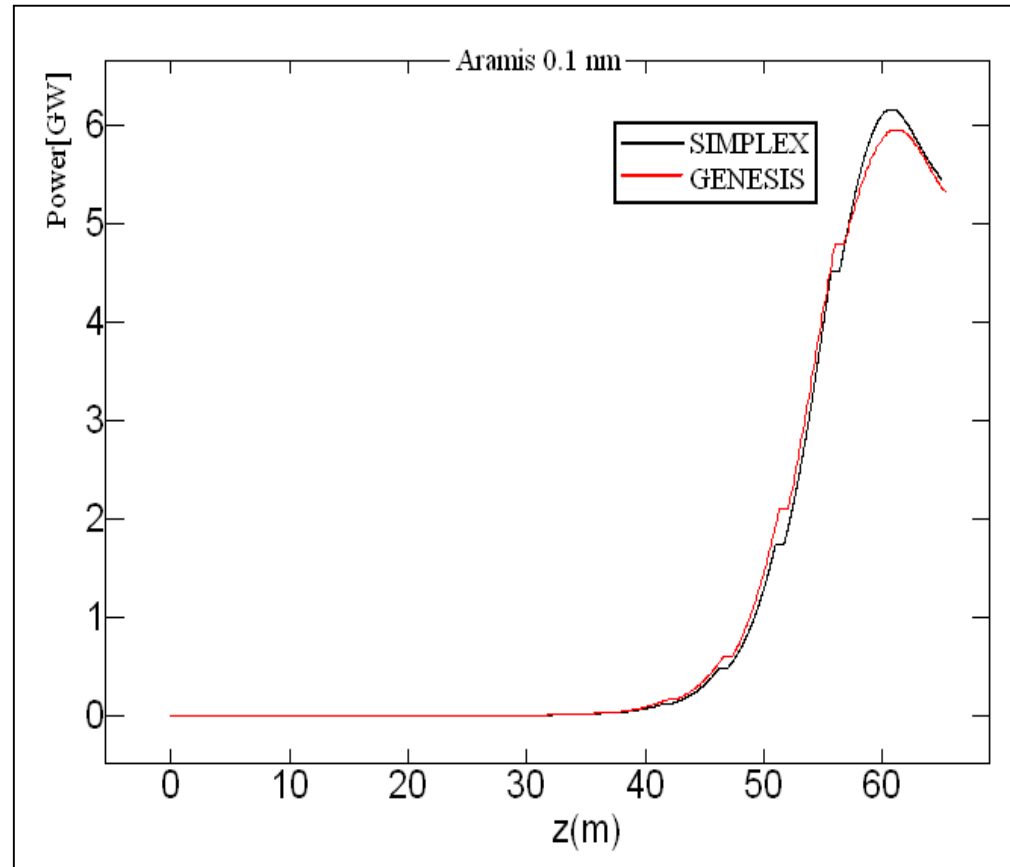
2. The FEL Performance without External Focusing (Aramis, Porthos)

Design Parameters

Energy	5.8 [GeV]
λ	0.1 [nm]
Bunch Charge	0.2 [nC]
Emittance	0.4 [mm.mrad]
Energy Spread	300 [keV]
Peak Current	2700 [A]
β	15 [m]

Results

	P_{\max} [GW]	L_{sat} [m]
SIMPLEX	6.15	60.37
GENESIS	5.95	60.75

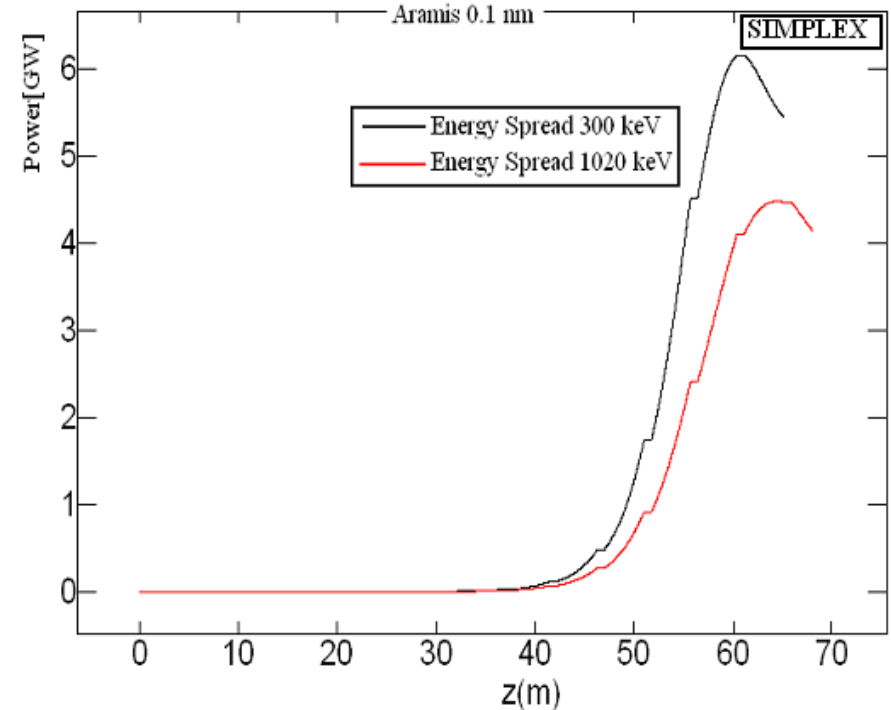
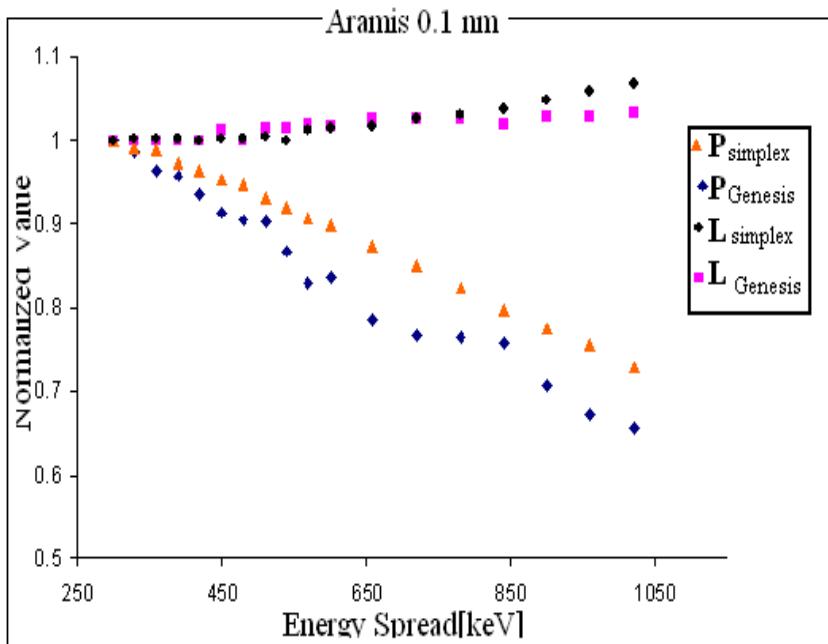


Dependence of FEL Performance on Beam Energy Spread

SIMPLEX		
Energy Spread[keV]	Pmax[GW]	Lsat[m]
300	6.15	60.37
330	6.09	60.40
360	6.08	60.40
390	5.98	60.40
420	5.93	60.37
450	5.86	60.40
480	5.82	60.50
510	5.73	60.61
540	5.66	60.37
570	5.58	61.14
600	5.53	61.17
660	5.37	61.40
720	5.22	61.83
780	5.06	62.19
840	4.89	62.55
900	4.77	63.17
960	4.64	63.93
1020	4.48	64.40

GENESIS		
Energy Spread[keV]	Pmax[GW]	Lsat[m]
300	5.95	60.75
330	5.86	60.75
360	5.74	60.75
390	5.69	60.75
420	5.57	60.75
450	5.43	61.52
480	5.38	60.75
510	5.37	61.56
540	5.16	61.61
570	4.94	61.92
600	4.98	61.70
660	4.68	62.28
720	4.56	62.33
780	4.55	62.24
840	4.51	61.92
900	4.20	62.46
960	4.00	62.37
1020	3.91	62.73

Dependence of FEL Performance on Beam Energy Spread



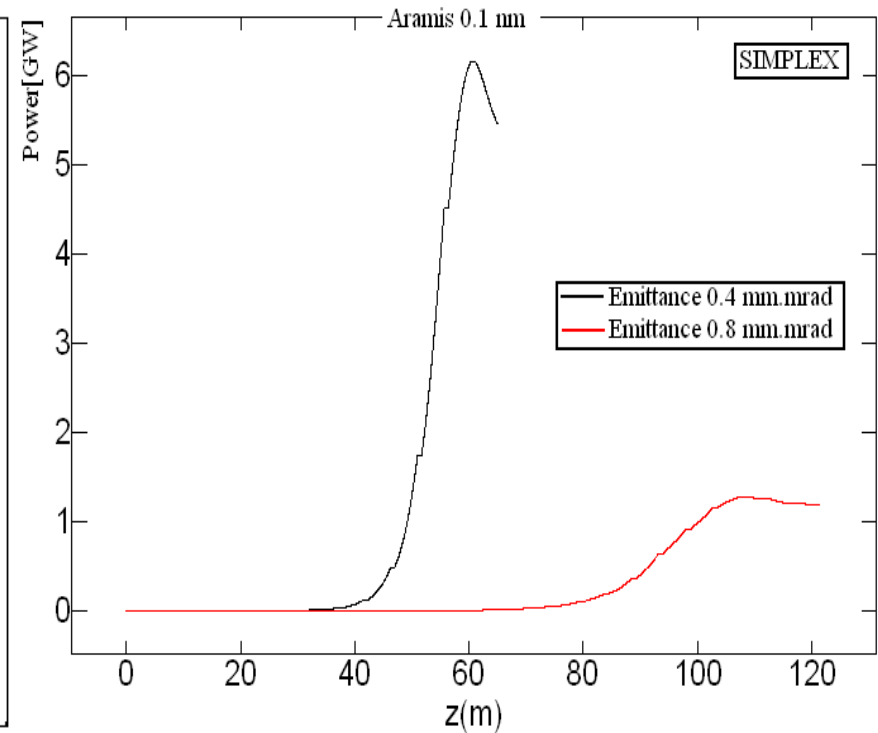
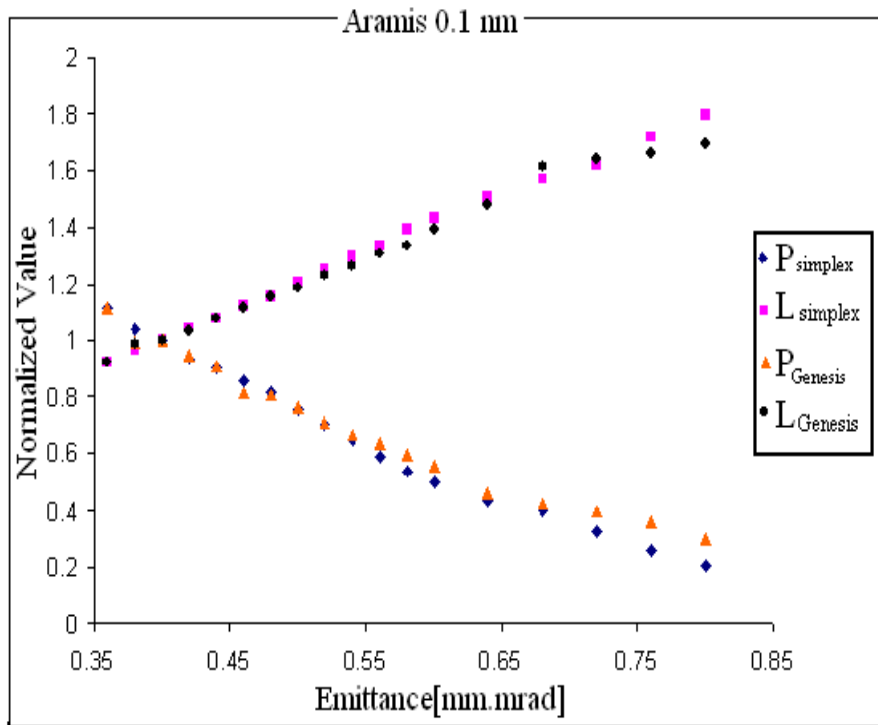
- *Saturation Power decrease by 30-35%*
- *Saturation Length increase by 3-7%*

Dependence of FEL Performance on Beam Emittance

SIMPLEX		
Emittance[mm. mrad]	P _{max} [GW]	L _{sat} [m]
0.36	6.85	55.67
0.38	6.38	58.38
0.4	6.15	60.37
0.42	5.75	63.03
0.44	5.56	65.10
0.46	5.27	67.82
0.48	5.03	69.80
0.5	4.66	72.94
0.52	4.35	75.42
0.54	3.99	78.18
0.56	3.61	80.39
0.58	3.32	83.87
0.6	3.08	86.13
0.64	2.68	90.90
0.68	2.45	94.88
0.72	2.03	98.05
0.76	1.57	103.65
0.8	1.27	108.25

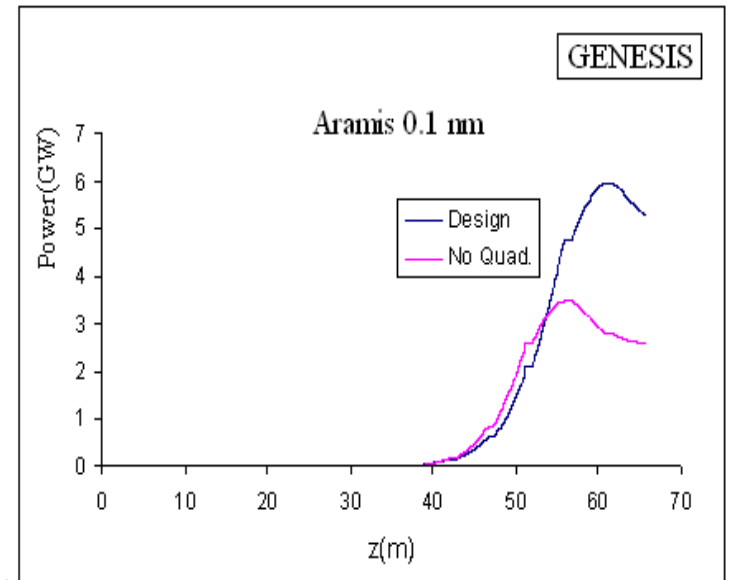
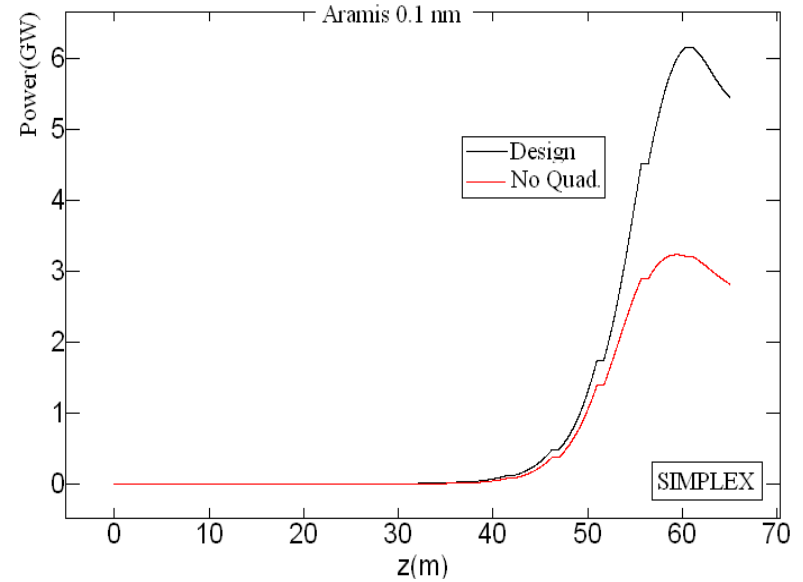
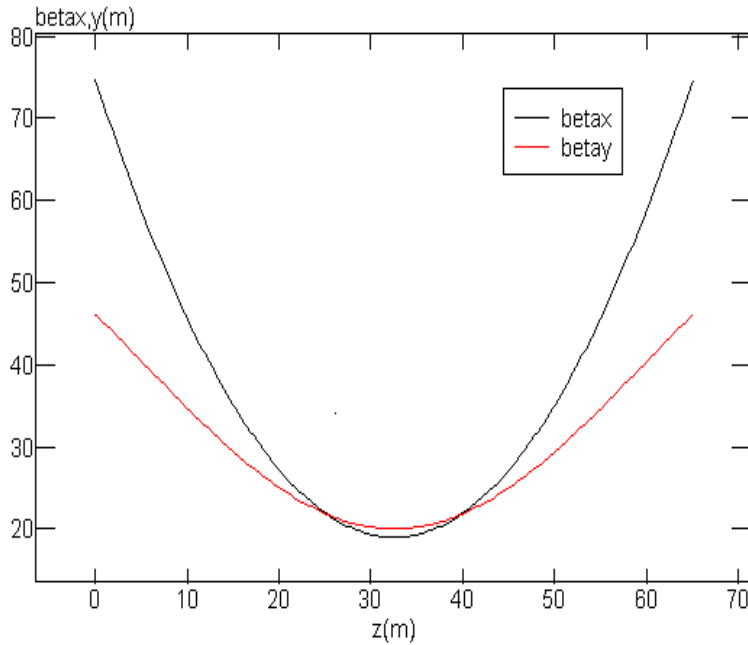
GENESIS		
Emittance[mm. mrad]	P _{max} [GW]	L _{sat} [m]
0.36	6.64	56.03
0.38	5.90	60.03
0.4	5.95	60.80
0.42	5.64	62.82
0.44	5.42	65.48
0.46	4.83	67.86
0.48	4.82	70.20
0.5	4.53	72.09
0.52	4.24	74.93
0.54	3.95	76.68
0.56	3.78	79.52
0.58	3.56	80.91
0.6	3.32	84.40
0.64	2.75	90.23
0.68	2.52	98.20
0.72	2.37	99.77
0.76	2.12	101.00
0.8	1.80	103.00

Dependence of FEL Performance on Beam Emittance



- *Saturation Power decrease by 70-80%*
- *Saturation Length increase by 70-80%*

The FEL Performance without External Focusing(Aramis)



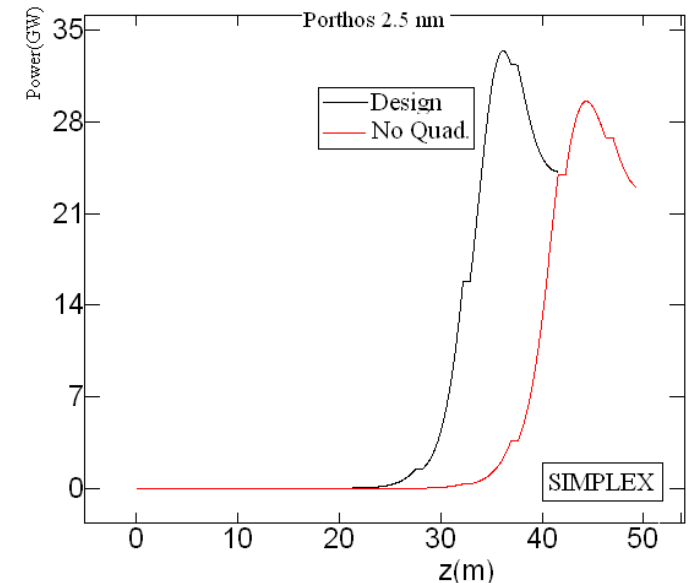
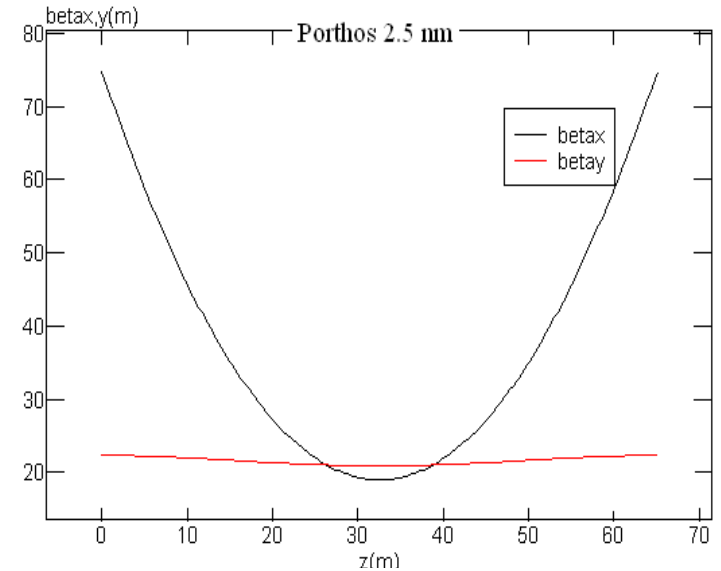
	$P_{max}[GW]$	$L_{sat}[m]$
SIMPLEX		
Design	6.15	60.37
No Quad.	3.23	59.41
GENESIS		
Design	5.95	60.75
No Quad.	3.48	56.02

The FEL Performance without External Focusing(Porthos)

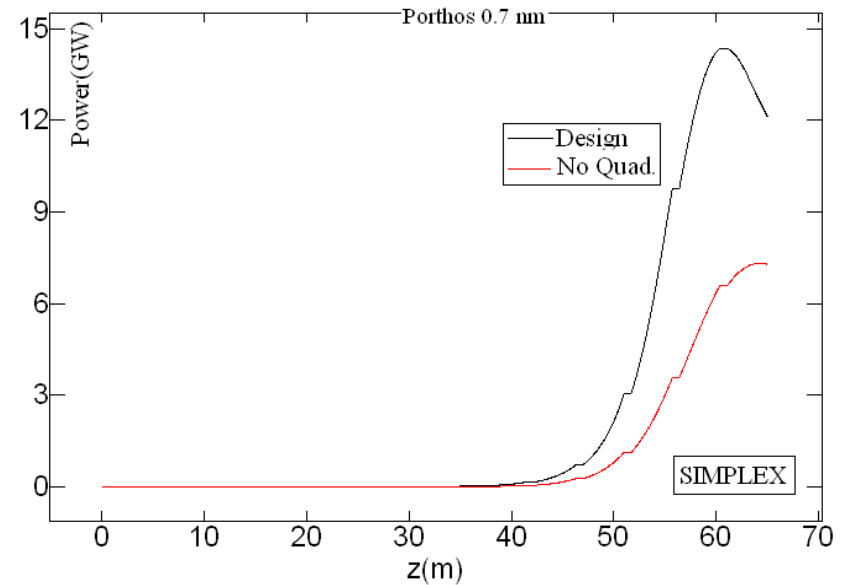
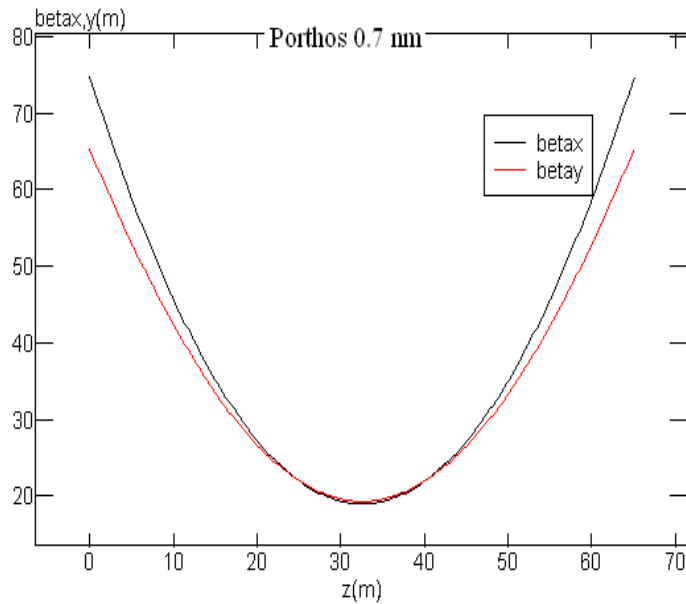
λ	0.7 nm	2.5 nm
Energy	3.4 GeV	3.4 GeV
Bunch Charge	0.2 nC	0.2 nC
Emittance	0.4 mm.mrad	0.4 mm.mrad
Energy Spread	300 keV	300 keV
Peak Current	2700 A	2700 A
β	15 m	15 m

Results for Porthos $\lambda=2.5\text{nm}$

	Pmax[GW]	Lsat[m]
Design	33.41	36.14
No Quad.	29.56	44.38



The FEL Performance without External Focusing (Porthos)



Results for Porthos $\lambda=0.7\text{nm}$

	Pmax[GW]	Lsat[m]
Design	14.34	60.40
No Quad.	7.31	64.30

Conclusion

1. For Aramis (0.1 nm)

- *Saturation Power decrease by 30-35% and Saturation Length remains the same when Energy spread is increasing from 0.3 MeV to 1.02 MeV*
- *When Emittance increasing from 0.4 to 0.8 mm.mrad Saturation Power decrease by 70-80% and Saturation Length increase by 70-80%*

2. External Focusing

- *When all quadrupoles are turned off the saturation length (SL) remains the same while the saturation power (SP) decreases about 41-47 % for Aramis (0.1nm). SL increasing about 23% and SP about 10% for Porthos (2.5nm) and SL increasing about 7% and SP decreasing about 49% for Porthos operating at the 0.7 nm wavelength.*